

SRC - Sealed Rectangular Connector

1. INTRODUCTION

1.1. Purpose

Product qualification testing of SRC connector system as per TEC-108-160018.

1.2. Scope

This report covers the electrical and environmental performance of the Sealed Rectangular Connector (SRC) system.

1.3. Conclusion

All part numbers listed in paragraph 4 conformed to the electrical, mechanical, and environmental performance requirements of TEC-108-160018.

1.4. Product Description

The Sealed Rectangular Connector (SRC) is designed to meet the need for a rugged, environmentally sealed connector system supporting power and low-level signal applications. The system is comprised of a wire-to-wire configuration and is based upon the MX150L and MX150 blade and receptacle type terminals. The design features all-in-one plug and receptacle housings with pre-assembled wire and interfacial seals with a Terminal Position Assurance (TPA) component to aid assembly.

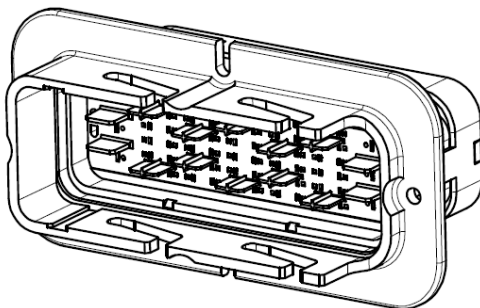


Figure 1: SRC 60+6 Mixed Power Blade Assembly Housing Mating Interface

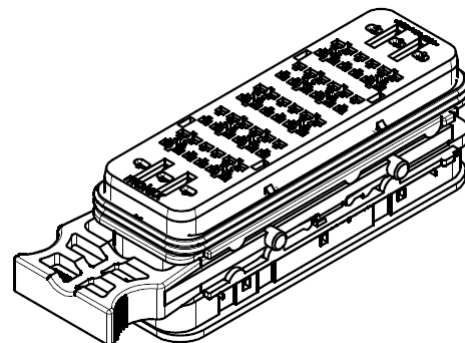


Figure 2: SRC 60+6 Mixed Power Female Receptacle Assembly Housing Mating Interface

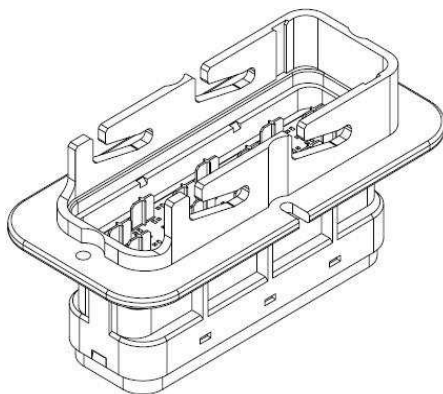


Figure 3: SRC 84 Pin Mixed Power Female Receptacle Housing Mating Interface

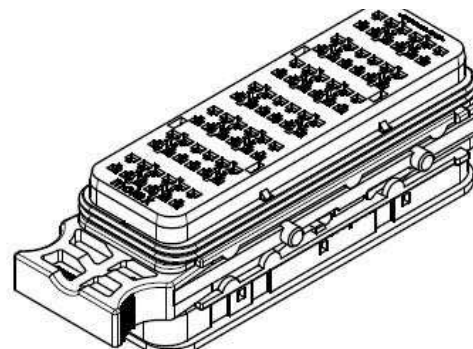


Figure 4: SRC Female 84 Pin Receptacle Housing Assembly

1.5. Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for testing.

| Test Group | Quantity | Description |
|------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TG A | 30 | 30 mated signal terminals |
| TG B | 6 | SRC 60+6 mated 2500021-1 Male & 2500005-1 Female pair |
| TG C | 8 | SRC 60+6 mated 2500021-1 Male & 2500005-1 Female pair |
| TG D | 6 | SRC 60+6 mated 2500021-1 Male & 2500005-1 Female pair |
| TG E | 6 | SRC 84 mated 2500024-1 Male & 2500008-1 Female pair |
| | 1 | SRC 60+6 mated 2500021-1 Male & 2500005-1 Female pair |
| TG F | 5 | SRC 60+6 mated 2500021-1 Male & 2500005-1 Female pair |
| TG G | 18 | SRC 60+6 Male Power Terminals inserted into 2500021-1 Male housings Female Power Terminals inserted into 2500005-1 Female housings |
| TG H | 8 | SRC 60+6 mated 2500021-1 Male & 2500005-1 Female pair |
| TG J & K | 1+1(J) | Sample 1 SRC 0+20 way mated connector populated with Nissei Denki EFN-2 (150°C High Temperature cable) 5.5mm ² power cables terminated to MX150L Male/Female terminals (P/Ns 194310016/194340003) Sample 2 SRC 84 way mated connector populated with Nissei Denki EFN-2 (150°C High Temperature cable) 0.5mm ² signal cable terminated to MX150 Signal Blade/Receptacle terminals (P/Ns 330000004/330122004) |
| | 1+1 (K) | |

Table 1: Quantities Tested

1.6. Qualification Test Sequence

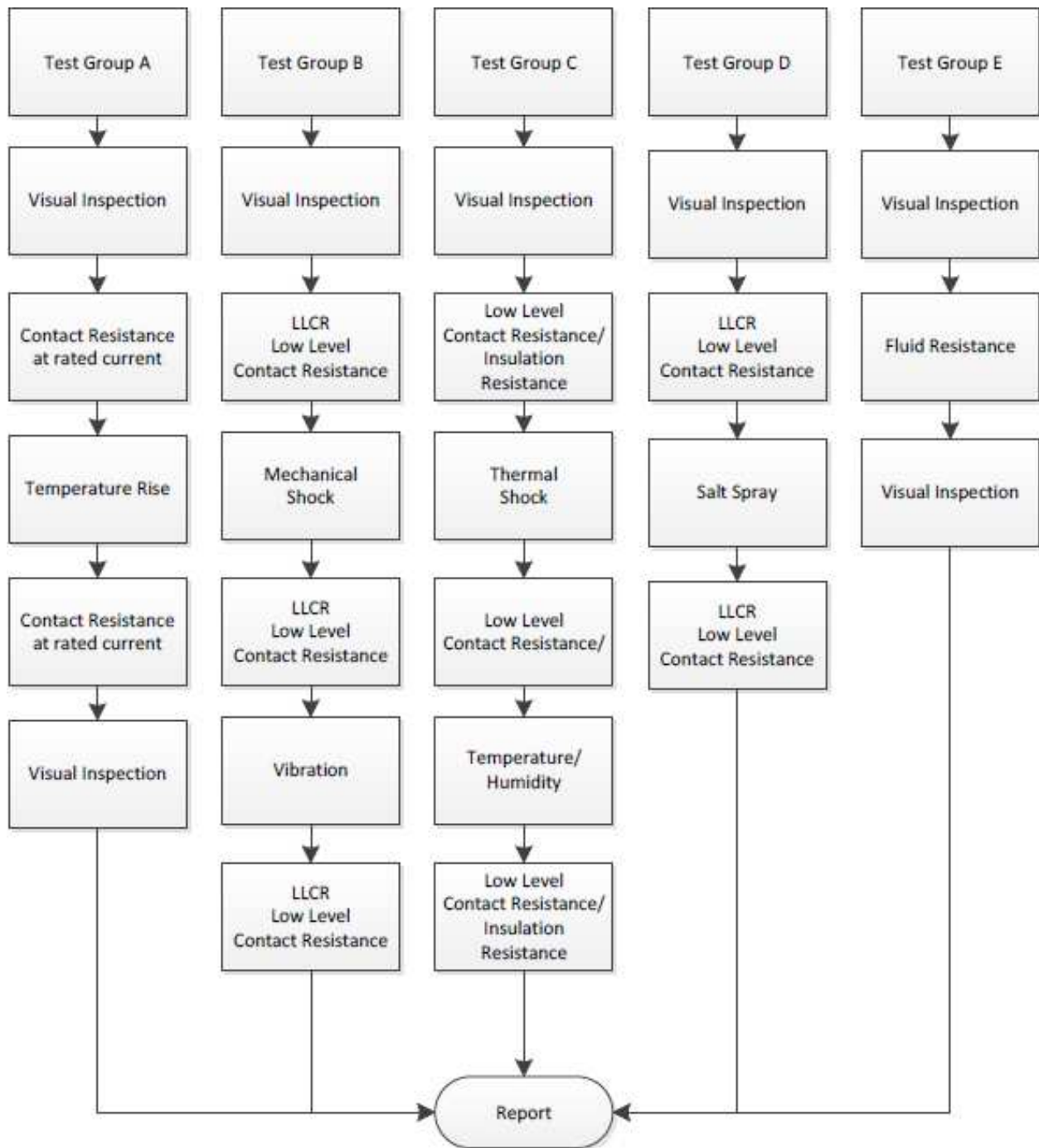


Figure 5: Test Sequence Part 1 of 2

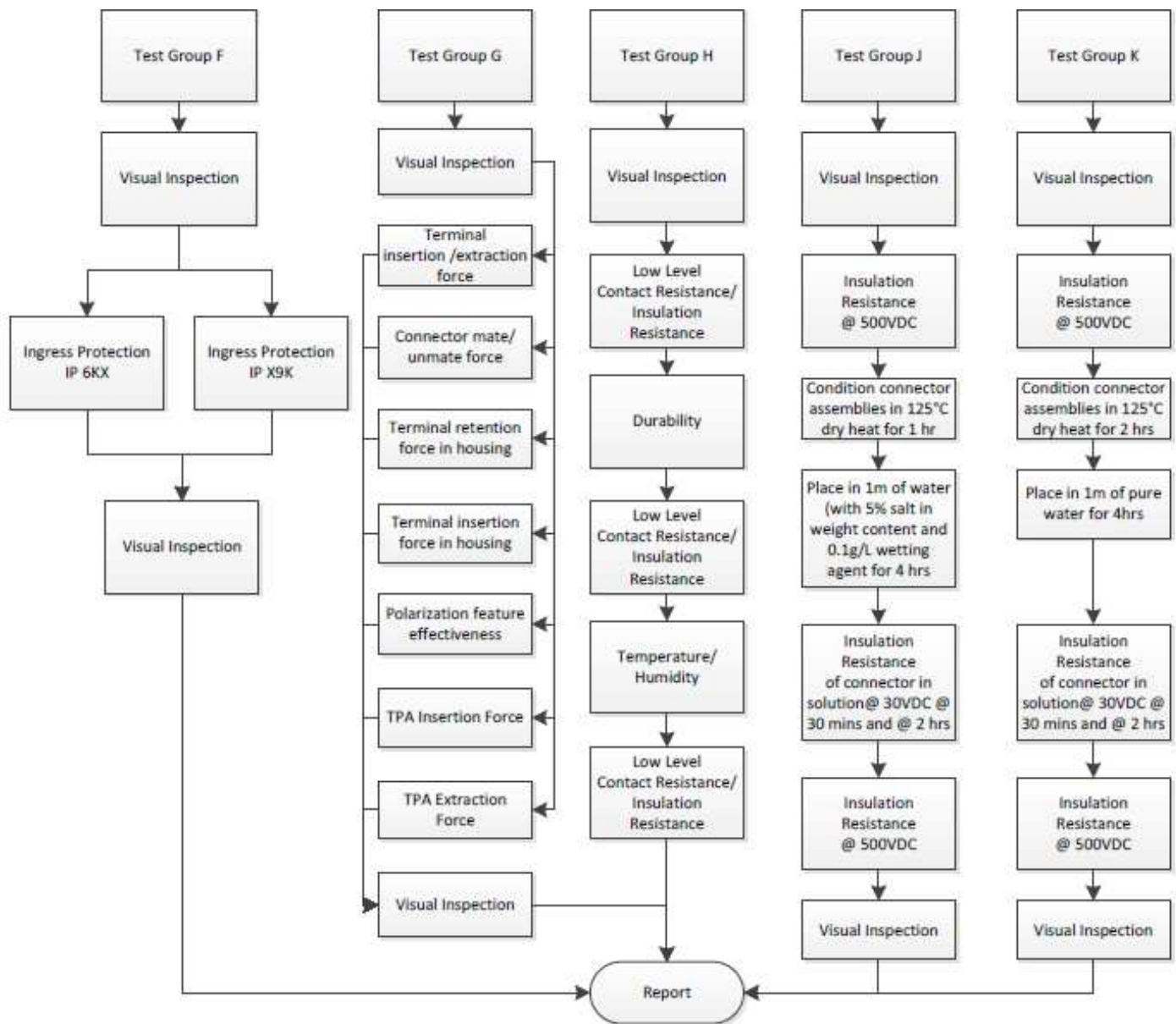


Figure 6: Test Sequence Part 2 of 2

1.7. Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

Temperature: 15°C to 35°C
 Relative Humidity: 20% to 80%

2. SUMMARY OF TESTING

2.1. Test Group TGA

| Test Ref | Item | Specification | Results | | | Comment |
|----------|----------------------------------------|--------------------------------------------------------------------------------|-------------------|-------|-------|---------|
| | | | Max | Mean | Min | |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.2.3 | Contact Resistance @ Rated Current | Signal (MX150) | [mΩ] | [mΩ] | [mΩ] | |
| | | 10mΩ Maximum | | | | |
| | | Initial | 9.47 | 8.57 | 8.01 | Pass |
| | | After current cycling | 9.54 | 8.61 | 8.11 | Pass |
| | | Parts were wired with 0.33mm ² cable, measurements taken at 10 Amps | | | | |
| | | Power (MX150L) 30mΩ | | | | |
| | | Maximum | | | | |
| | | Initial | 1.43 | 1.27 | 1.20 | Pass |
| | | After current cycling | 2.83 | 1.37 | 1.20 | Pass |
| | | Parts were wired with 6.0mm ² cable, measurements taken at 30 Amps | | | | |
| 5.2.5 | Temperature Rise (via Current Cycling) | Temperature rise over Ambient: 55°C | [°C] | [°C] | [°C] | |
| | | Maximum | | | | |
| | | Signal (MX150) | | | | |
| | | Initial | 43.74 | 34.43 | 27.78 | Pass |
| | | Final | 45.00 | 31.17 | 22.52 | Pass |
| | | Parts were wired with 0.33mm ² cable, measurements taken at 10 Amps | | | | |
| | | Power (MX150L) | | | | |
| | | Initial | 48.87 | 38.14 | 22.55 | Pass |
| | | Final | 47.03 | 37.89 | 28.41 | Pass |
| | | Parts were wired with 6.0mm ² cable, measurements taken at 30 Amps | | | | |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |

Table 2: Test Results for Test Group A

2.2. Test Group TGB

| Test Ref | Item | Specification | Results | | | Comment |
|----------|---------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------|---------------|---------------|---------|
| | | | Max | Mean | Min | |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.2.2 | Initial LLCR (Low Level Contact Resistance) | 10 mΩ (MX150) | [mΩ] | [mΩ] | [mΩ] | |
| | | 30mΩ (MX150L) | | | | |
| | | Maximum [Initial] | | | | |
| | | Signal MX150* | 9.2 | 5.9 | 4.9 | Pass |
| | | Power MX150L* | 11.4 | 6.0 | 3.4 | Pass |
| 5.3.13 | Mechanical Shock | 10 mΩ MAXIMUM (change from initial contact resistance) | Delta [mΩ] | Delta [mΩ] | Delta [mΩ] | |
| | | Signal MX150 | 1.6 | 0.2 | -1.1 | Pass |
| | | Power MX150L | 1.4 | -1.3 | -5.7 | Pass |
| | | No Discontinuity > 1ms with a current of 100 mA | No Discontinuity > 1ms with a current of 100 mA | | | Pass |
| 5.3.14 | Vibration | 10 mΩ MAXIMUM (change from initial contact resistance) | Delta [mΩ] | Delta [mΩ] | Delta [mΩ] | |
| | | Signal MX150 | 0.7 | -0.3 | -3.3 | Pass |
| | | Power MX150L | 0.3 | -3.0 | -8.4 | Pass |
| | | No Discontinuity > 1ms with a current of 100 mA | No Discontinuity > 1ms with a current of 100 mA | | | Pass |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |

Table 3: Test Results for Test Group B

* Bulk Signal Resistance 6.7mΩ, Bulk Power Resistance 1.2mΩ for 215mm length.

2.3. Test Group TGC

| Test Ref | Item | Specification | Results | | | Comment |
|----------|---------------------------------------------------|-------------------------------------------------------------|-------------------|------|------|---------|
| | | | Max | Mean | Min | |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.2.2 | Initial LLCR (Low Level Contact Resistance) | 30mΩ (MX150L) | [mΩ] | [mΩ] | [mΩ] | |
| | | 10 mΩ (MX150) Maximum [Initial] | | | | |
| | | Power MX150L | 6.0 | 4.2 | 3.2 | Pass |
| | | Signal MX150 | 8.9 | 8.0 | 7.3 | Pass |
| 5.2.4 | Insulation Resistance | 20MΩ Minimum @ 500VDC | IR > 50,000MΩ | | | Pass |
| 5.4.16 | Thermal Shock | 20mΩ Maximum (change from initial contact resistance) | [mΩ] | [mΩ] | [mΩ] | |
| | | Power MX150L | 12.4 | 5.2 | 1.9 | Pass |
| | | Signal MX150 | 1.0 | 0.2 | -0.9 | Pass |
| | | Visual: No Damage | No Damage visible | | | Pass |
| 5.4.17 | Temperature Humidity | 20mΩ Maximum (change from initial contact resistance) | [mΩ] | [mΩ] | [mΩ] | |
| | | Power MX150L | 15.1 | 8.7 | 2.8 | Pass |
| | | Signal MX150 | 6.4 | 0.9 | -0.9 | Pass |
| | | Insulation Resistance 20MΩ Minimum @ 500VDC | IR > 50,000MΩ | | | Pass |
| | | Visual: No Damage | No Damage visible | | | Pass |

Table 4: Test Results for Test Group C

2.4. Test Group TGD

| Test Ref | Item | Specification | Results | | | Comment |
|----------|---------------------------------------------------|-----------------------------------------------------------------|-------------------|----------------|----------------|--------------|
| | | | Max | Mean | Min | |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.2.2 | Initial LLCR (Low Level Contact Resistance) | 10 mΩ (MX150) 30mΩ (MX150L) Maximum [Initial] | [mΩ] | [mΩ] | [mΩ] | |
| | | Signal MX150* Power MX150L* | 5.85 5.79 | 5.11 3.67 | 3.77 1.99 | Pass Pass |
| 5.4.18 | Salt Spray | 20 mΩ MAXIMUM (change from initial contact resistance) | Delta [mΩ] | Delta [mΩ] | Delta [mΩ] | |
| | | Signal MX150* Power MX150L* | 1.72 1.23 | -0.07 -0.56 | -2.12 -2.61 | Pass Pass |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |

Table 5: Test Results for Test Group D

* Bulk Signal Resistance 2.35mΩ for 73mm length, Bulk Power Resistance 0.37mΩ for 65mm length.

2.5. Test Group TGE

| Test Ref | Item | Specification | Results | | | Comment |
|----------|-------------------|--------------------|----------------------------------------------------|------|-----|---------|
| | | | Max | Mean | Min | |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.4.19 | Fluid Resistance | Visual : No Damage | Reference Section 9.0 for Fluid Resistance results | | | Pass |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | *Pass |

Table 6: Test Results for Test Group E

* The following observation was noted that during the Fluid Immersion Test for diesel that lifting of the edge of the rear cover feature from the female housing occurred. This was due to diesel impregnating the seal.

2.6. Test Group TGF

| Test Ref | Item | Specification | Results | | | Comment |
|----------|---------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------|-----|---------|
| | | | Max | Mean | Min | |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.4.20 | IP 69K ISO 20653 | IP 6KX - expose mated connectors to suspended dust | "No infiltrated dust could be visually detected inside the plug connectors" Reference Fraunhofer Institute Test Report US 06993/2014 | | | Pass |
| | | IP X9K - expose mated connectors to water from any direction at high temperature and pressure | Reference Fraunhofer Institute Test Report US 06775/2014 | | | Pass |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |

Table 7: Test Results for Test Group F

2.7. Test Group TGG

| Test Ref | Item | Specification | Results | | | Comment |
|----------|---------------------------------------|------------------------------------------------------------|-------------------|--------------|--------------|---------|
| | | | Max | Mean | Min | |
| 5.3.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.3.6 | Terminal Insertion/Extraction | Maximum Insertion Signal MX150: 5N Max | [N] 2.8 | [N] 2.2 | [N] 1.72 | Pass |
| | | Power MX 150L: 15N Max | 14.7 | 12.5 | 10.2 | Pass |
| | | Minimum Withdrawal Signal MX150: 1N Min Power | 2.2 | 2.0 | 1.64 | Pass |
| | | MX 150L: 9N Min | 20.4 | 16.2 | 16.2 | Pass |
| 5.3.7 | Connector Mate/Unmate | 250N Maximum Mating Force | [N] 247 | [N] 225 | [N] 211 | Pass |
| | | Unmating Force | 207 | 189.75 | 161 | Pass |
| | | Signal MX150: 50N Min Female | [N] 96 | [N] 92 | [N] 86 | Pass |
| 5.3.8 | Terminal Retention Force in Housing | Male | 90 | 88 | 85 | Pass |
| | | Power MX 150L :111N Min Female | 325 | 303 | 289 | Pass |
| 5.3.9 | Terminal Insertion Force Into Housing | Male Power MX150L terminals into male housing | [N] 19.10 | [N] 14.09 | [N] 10.90 | Pass |
| | | Female Power MX150L terminal into Female housings | 23.50 | 14.19 | 9.67 | Pass |
| 5.3.10 | Polarization Feature Effectiveness | 220N maximum Sample should not mate | No mating | | | Pass |
| 5.3.11 | TPA Insertion Force | 130N Maximum Female | [N] 92.7 | [N] 83.8 | [N] 73.8 | Pass |
| | | Male | 28.9 | 23.0 | 16.6 | Pass |
| 5.3.12 | TPA Extraction Force | 130N Maximum Female | [N] 92.9 | [N] 68.6 | [N] 54.4 | Pass |
| | | Male | 15.5 | 13.8 | 13.0 | Pass |
| 5.3.1 | Visual Inspection | No Damage | No damage visible | | | Pass |

Table 8: Test Results for Test Group G

2.8. Test Group TGH

| Test Ref | Item | Specification | Results | | | Comment |
|----------|---------------------------------------------|-------------------------------------------------------|-------------------|------|------|---------|
| | | | Max | Mean | Min | |
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.2.2 | Initial LLCR (Low Level Contact Resistance) | 30mΩ (MX150L) | [mΩ] | [mΩ] | [mΩ] | |
| | | 10 mΩ (MX150) Maximum [Initial] | | | | |
| | | Power MX150L | 6.5 | 4.5 | 2.9 | Pass |
| | | Signal MX150 | 9.9 | 8.3 | 7.7 | Pass |
| 5.2.4 | Insulation Resistance | 20MΩ Minimum @ 500VDC | > 50,000MΩ | | | Pass |
| 5.3.15 | Durability | 20mΩ Maximum (change from initial contact resistance) | [mΩ] | [mΩ] | [mΩ] | |
| | | Power MX150L | -0.0 | -1.3 | -3.4 | Pass |
| | | Signal MX150 | 2.76 | 0.4 | -1.7 | Pass |
| | | Visual: No Damage | No Damage visible | | | Pass |
| 5.4.17 | Temperature/ Humidity | 20mΩ Maximum (change from initial contact resistance) | [mΩ] | [mΩ] | [mΩ] | |
| | | Power MX150L | 13.2 6.1 | 0.9 | | Pass |
| | | Signal MX150 | 19.1 4.1 | -0.6 | | Pass |
| | | 20MΩ Minimum @ 500VDC | IR > 50,000MΩ | | | Pass |
| | | Visual: No Damage | No Damage visible | | | Pass |

Table 9: Test Results for Test Group H

2.9. Test Group TGJ

| Test Ref | Item | Specification | Results | | | Comment |
|-------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------|------------------------|------------------------|--------------|
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.2.4 | Insulation Resistance | 20 MΩ Minimum at 500VDC SRC84way SRC 0+20way | IR > 50,000MΩ IR > 50,000MΩ | | | Pass Pass |
| N/A | Precondition | Dry heat for 1hr @125°C | Completed | | | N/A |
| 5.4.21 | Water Immersion | Placed in water at a depth of 1m with a 5% salt in weight content and 0.1g/L wetting agent for 4hrs | Completed | | | N/A |
| | Insulation Resistance (Test Sample in Solution) | 5000MΩ Minimum @ 30VDC SRC84way SRC 0+20way | @30mins | @2hrs | @4hrs | Pass Pass |
| | | | IR>5000MΩ IR>5000MΩ | IR>5000MΩ IR>5000MΩ | IR>5000MΩ IR>5000MΩ | |
| | Insulation Resistance (Post Water Immersion) | 1000 MΩ Minimum at 500VDC SRC84way SRC 0+20way | IR > 50,000MΩ IR > 50,000MΩ | | | Pass Pass |
| Visual Inspection | SRC84way SRC 0+20way | No Moisture Present No Moisture Present | | | Pass Pass | |
| 5.1.1 | Visual Inspection | No Damage | No damage/deformation to cable visible | | | Pass |

Table 10: Test Results for Test Group J

All connector samples that underwent immersion test were bussed so that all adjacent cables could be tested at once to reduce testing time between individual adjacent terminals (see Figure 26).

Insulation Resistance test pre/post immersion occurred on mated connectors, while the TEC-108-160018 Item 5.2.4 Insulation Resistance requirement is on the unmated connector.

Item 5.4.21(Water Immersion) calls for Insulation resistance testing at 1000MΩ Minimum @ 500VDC while test 5.2.4 (Insulation Resistance) calls for 20MΩ Minimum @ 500VDC. The Insulation Resistance test was carried out in aqueous solution (5000MΩ Minimum @ 30VDC) at the 30th minute, 2 hour & 4 hour intervals between the connector system & solution.

2.10. Test Group TGK

| Test Ref | Item | Specification | Results | | | Comment |
|----------|---------------------------------------------------|------------------------------------------------------|--------------------------------------------|------------------------|------------------------|--------------|
| 5.1.1 | Visual Inspection | No Damage | No damage visible | | | Pass |
| 5.2.4 | Insulation Resistance | 20 MΩ Minimum at 500VDC SRC84way SRC 0+20way | IR > 50,000MΩ IR > 50,000MΩ | | | Pass Pass |
| N/A | Precondition | Dry heat for 2hr @125°C | Completed | | | N/A |
| 5.4.22 | Pure Water Immersion | Placed in “pure” water at a depth of 1m for 4hrs | Completed | | | N/A |
| | Insulation Resistance (Test Sample in Solution) | 5000MΩ Minimum @ 30VDC SRC84way SRC 0+20way | @30mins | @2hrs | @4hrs | Pass Pass |
| | | | IR>5000MΩ IR>5000MΩ | IR>5000MΩ IR>5000MΩ | IR>5000MΩ IR>5000MΩ | |
| | Insulation Resistance (Post Pure Water Immersion) | 1000 MΩ Minimum at 500VDC SRC84way SRC 0+20way | IR > 50,000MΩ IR > 50,000MΩ | | | Pass Pass |
| | Visual Inspection | SRC84way SRC 0+20way | No Moisture Present No Moisture Present | | | Pass Pass |
| 5.1.1 | Visual Inspection | No Damage | No damage/deformation to cable visible | | | Pass |

Table 11: Test Results for Test Group K

3. EQUIPMENT USED

| Item | Equipment used |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Contact Resistance | HP Milliohm meter Cal No.1650 |
| Insulation Resistance | Omnia Cal No. 3010 |
| Force Testing | Zwick Force Tester Cal No. 3711 |
| Fluid Resistance | Smithers Rapra Test Report 49085 |
| | Aqueous Urea test conducted at Molex Ireland Sanyo Gallenkamp Cal No. 2137 RS Timer Cal No. 2658 |
| Salt Spray | WEISS TECHNIK SC/KWT 450 Cal No. 2505 |
| Mechanical Shock & Vibration | Contech Research Inc. Reference Test Report # 214361A |
| IP69K | IP6KX Fraunhofer Institute Reference Test Report No. US 06993/2014 |
| | IPX9K Fraunhofer Institute Reference Test Report No. US 06775/2014 |
| Temperature Rise | Agilent Data Acquisition unit, Cal No. 3136 Xantrex Power Supply Unit Cal No. 3508 |
| Thermal Shock | CTS Thermal Shock Cal No. 3849 |
| Temperature/Humidity | CTS Temperature/Humidity Cal No. 3189 |
| Insulation Resistance in Aqueous solution | Kikusui TOS7200 Cal No.3948 |
| Water/Pure Water Immersion | Rabone 1m Rule Cal#2911 RS Timer Cal#2658 |
| Precondition stage prior to Water Immersion | Genlab Oven OVI26SF |
| | Extech 421501 Type K Thermocouple Cal No. 3215 |

4. APPENDICES

4.1. Appendix A: Test Set-ups TGB & TGD

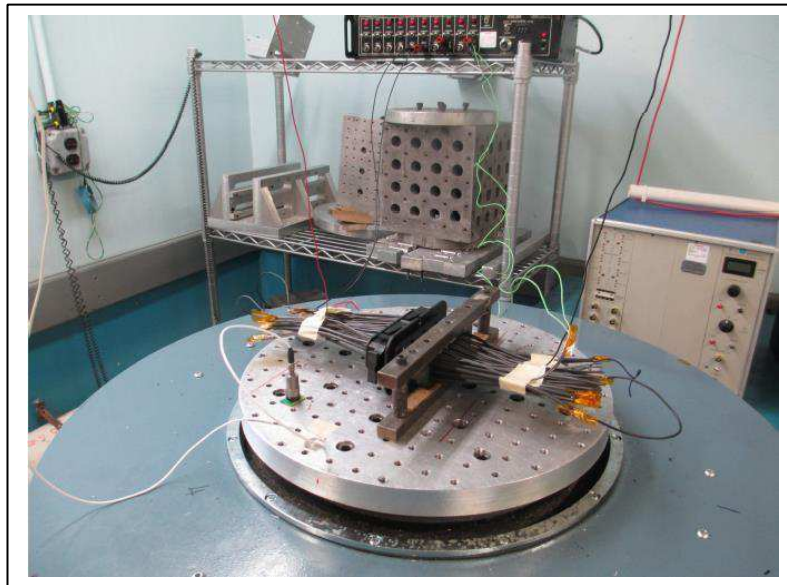


Figure 7: Test Group B : Contech Research Inc.: Mechanical Shock/Vibration Typical Test Setup

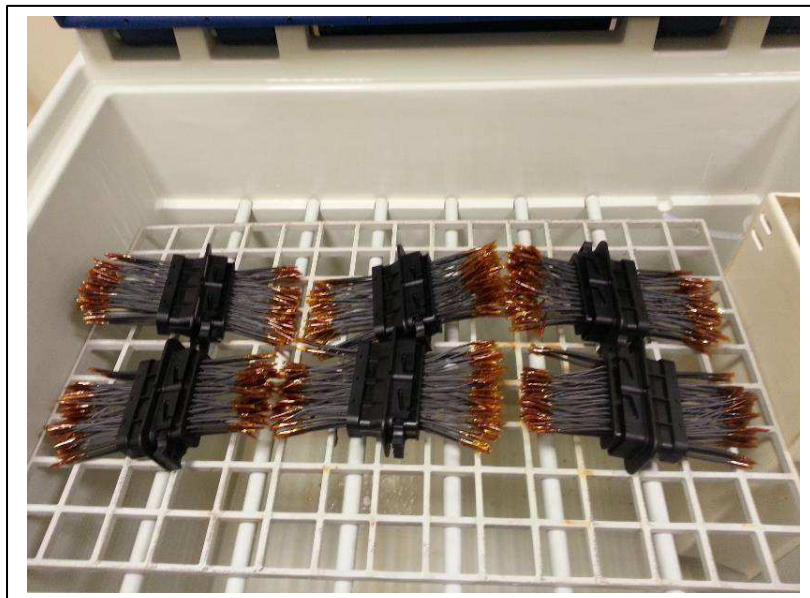


Figure 8: Test Group D : Setup of Samples in Salt Spray chamber

4.2. Appendix B: Fluid Resistance Test Set-up TGE

| Fluid Required | Concentration | Temperature | Fluid Brand Used |
|----------------------|---------------|-------------|-------------------------|
| Motor Oil 30 wt | 100% | 85±3°C | IRM 902 |
| Brake Fluid | 100% | 85±3°C | Morris Dot 3 & 4 |
| Diesel Fuel | 90/10% | 60±3°C | IRM 903/Xylene |
| 50/50 Antifreeze Mix | 50/50 | 85±3°C | ES Compleat Fleetguard |
| Roundup Original | 7.50% | 23±3°C | Round Up GC Concentrate |
| Gear Oil 90 wt | 100% | 85±3°C | Morris EP90W/90 |
| Aqueous Urea | 32.5% | 23±3°C | Purchem AdBlue |

Table 12: List of fluids used at External Test Laboratory



Figure 9: Observation that lifting of the edge of the rear cover feature from the female housing part occurred. This was due to diesel impregnating the seal

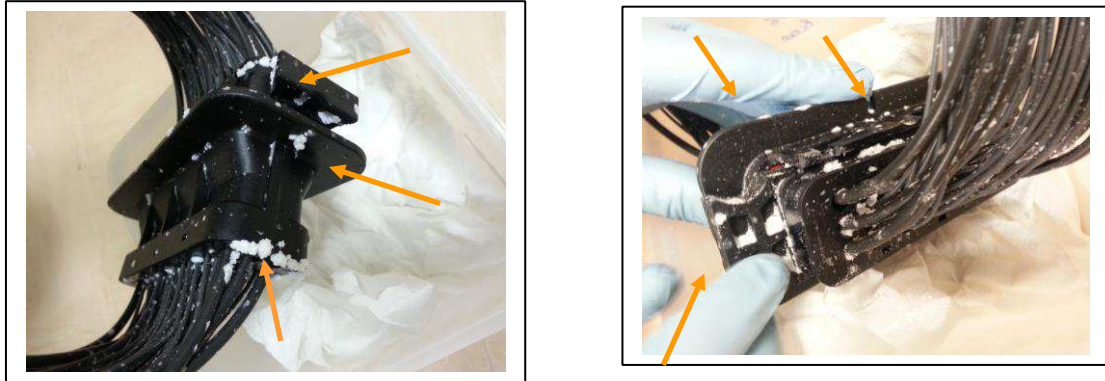


Figure 10: Fluid Resistance test: ADBLUE, formation of Urea crystals on part as water evaporates from ADBLUE solution during 24 Hour air dry cycles.

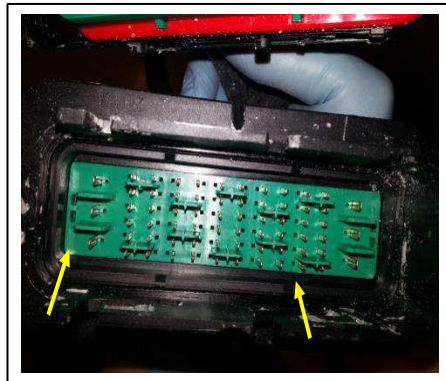


Figure 11: No Urea crystals on mating surface of part

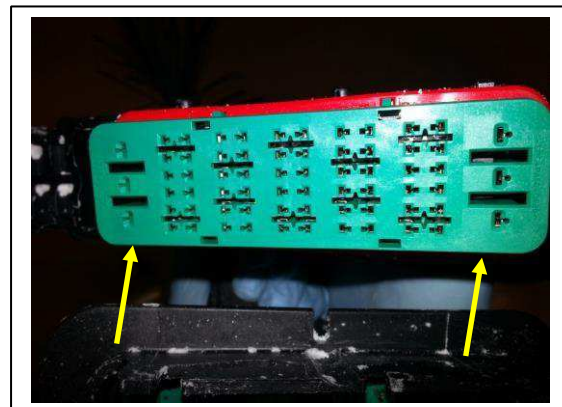
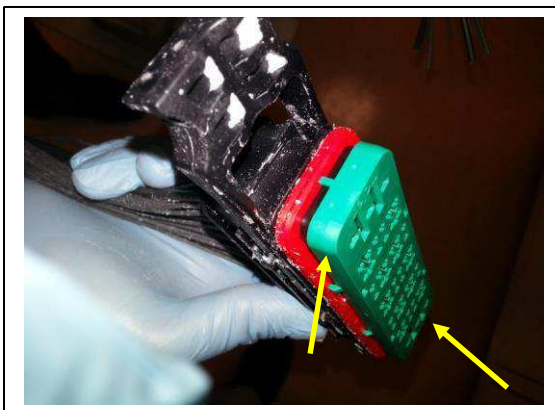


Figure 12: No Urea crystals on mating surface of part

4.3. Appendix C: (IP69K) SET-UPS TGF

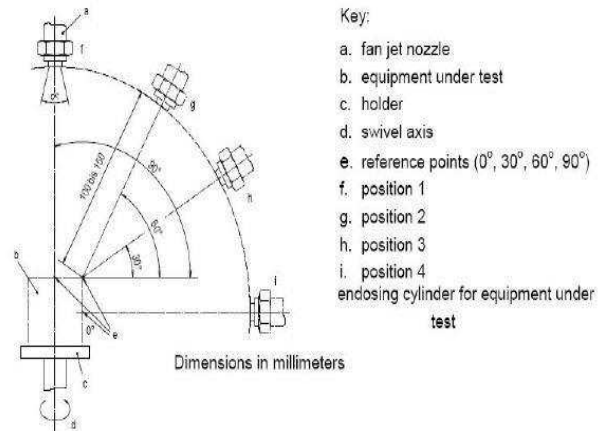


Figure 13: : IPX9K Test setup for determining protection against high pressure/steam jet cleaning

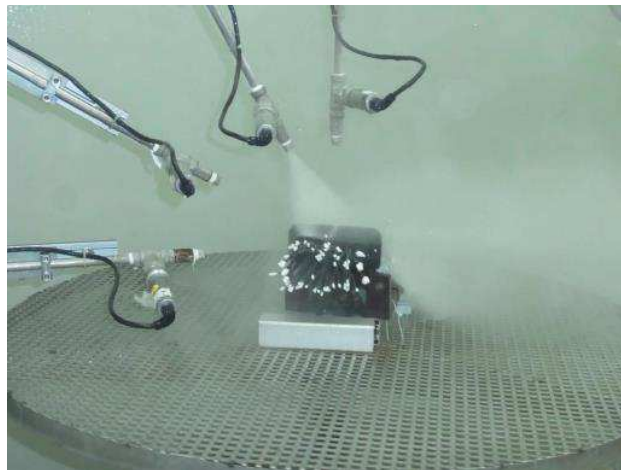


Figure 14: specimen during the steam jet test (30° angle)

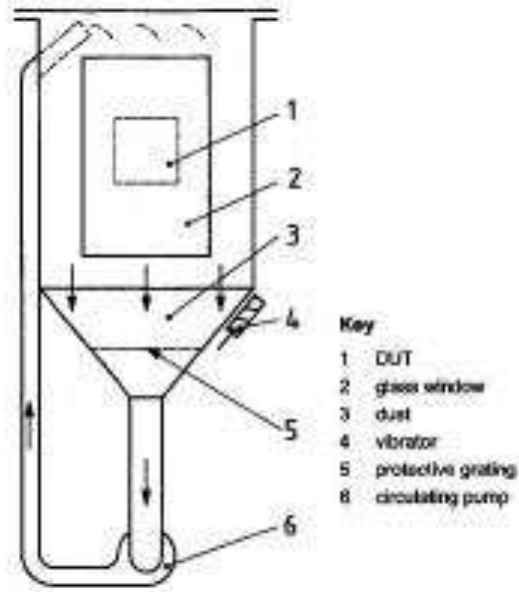


Figure 15: Test set-up for IP6KX (example of a dust chamber with vertical flow of the air/dust mixture)



Figure 16: Specimens in the dust test chamber for IP6KX (after test)

4.4. Appendix D: Terminal Insertion Set-up TGG

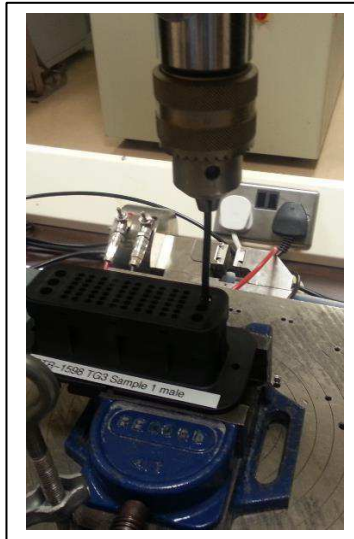


Figure 17: Setup of Zwick/Roell force tester for male terminal insertion into male housing

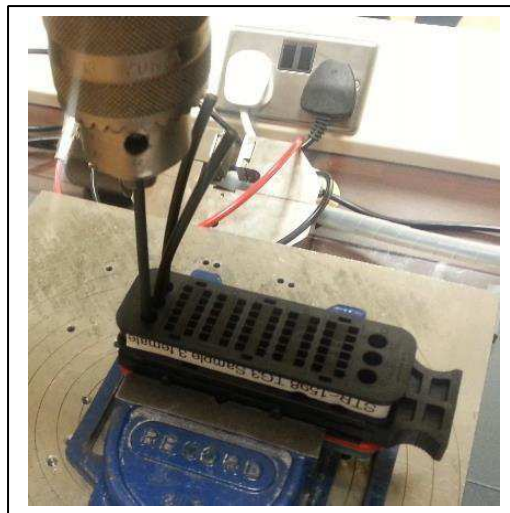


Figure 18: Setup of Zwick/Roell force tester for female terminal insertion into female housing

4.5. Appendix E: Water Immersion Test Set-Up TGJ & TGK

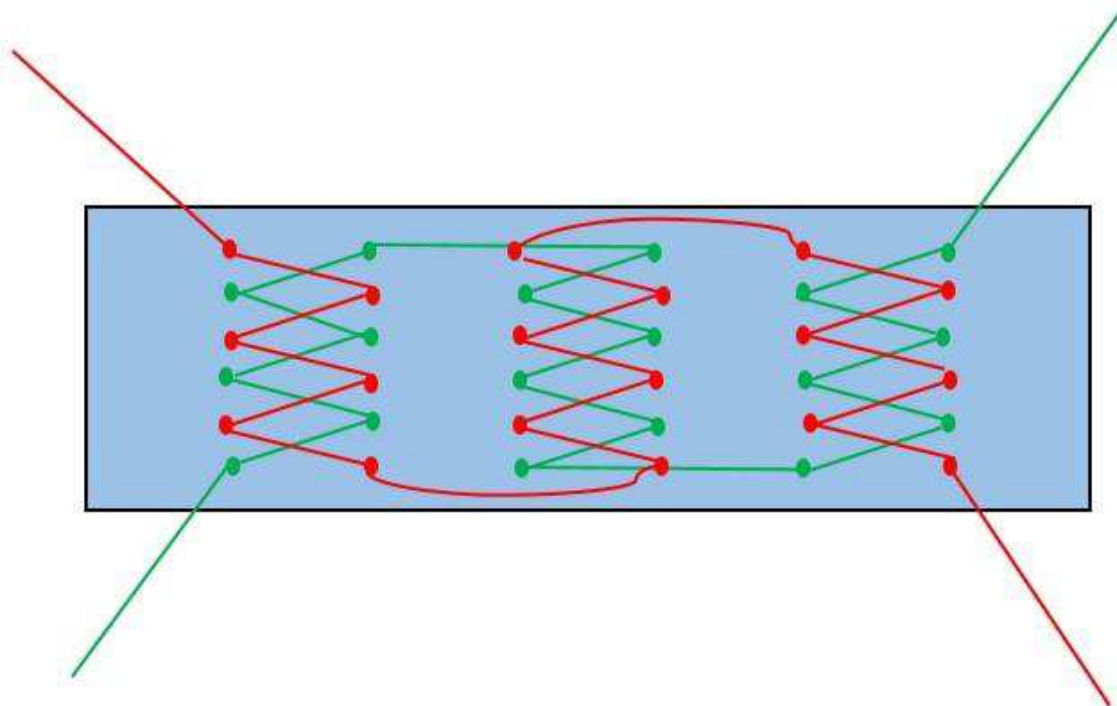


Figure 19: demonstrates the wiring diagram used to bus the connector harness

Harnesses were bussed in this way so that all terminals were wired opposite to its neighboring terminals,
 Note: only 3 pockets are shown in the wiring diagram as the diagram repeats itself across the connector



Figure 20: Visual Inspection Post Insulation Resistance/Immersion Test, No ingress of solution

5. REVISION HISTORY

| Rev Ltr | Brief Description of Change | Date | Dwn | Apvd |
|---------|-----------------------------|-----------|-----|------|
| A | Initial Release | 15-Apr-21 | JF | DM |